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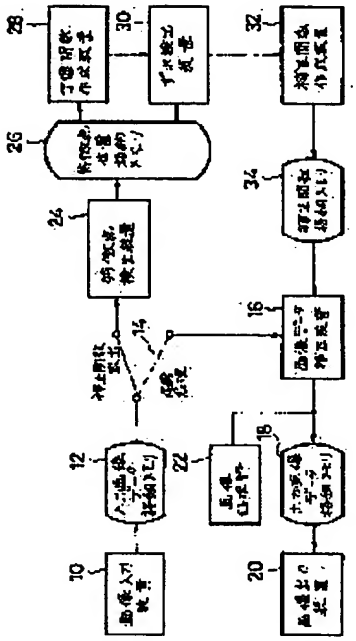
(54) IMAGE PROCESSOR AND DISTORTION CORRECTING METHOD OF IMAGE PROCESSOR

(57)Abstract:
PURPOSE: To obtain a correction function for correcting distortion from image data.
CONSTITUTION: A checkered characteristic pattern is picked up by an image input device 10 and feature points (intersection) are detected from the image pickup data. A mapping function obtained when a pinhole camera is used as a television camera is generated from an array of feature points nearby the center and the position on a screen. The reference position of the feature points as to the whole screen is calculated from the mapping function and compared with the actual position on the screen to calculate the correction function, which is stored in a correction function generating device 32. Then, the input image is normally corrected with the correction function and outputted to an image output device 20.



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[Claim(s)]

[Claim 1] A focus extract production process of extracting the focus from image pick-up data of a pattern for proofreading whose arrangement of the focus it is the distortion amendment method in an image processing system which amends distortion of an image in image pick-up data obtained with image pick-up equipment, and is known, A location of the focus of a predetermined number near the center in image pick-up data obtained by this focus extract means, Based on data about a pattern for proofreading, image pick-up equipment is assumed to be a pinhole camera. A mapping function calculation production process which computes a mapping function which shows both relation, and a criteria location calculation production process which computes a criteria-almost location in image pick-up data of the focus all over the districts of image pick-up data using a mapping function obtained with this mapping function calculation means, A distortion amendment method characterized by having a correction function calculation production process which computes a correction function for amending a location of the focus based on a location of the focus obtained by this criteria location calculation means, and a location of the focus in image data, and using this correction function for distortion amendment of image pick-up data.

[Claim 2] A distortion correction function calculation method in an image processing system which amends distortion of an image in image pick-up data obtained with image pick-up equipment characterized by providing the following A focus extract production process of having a checkered pattern and extracting an intersection location from image pick-up data about a pattern for proofreading whose arrangement of an intersection in a pattern is known as the focus A location of the focus obtained by this focus extract means A correction function calculation production process which computes a correction function for amending a location of the focus based on data about a pattern for proofreading Using a correction function obtained according to an implication and a correction function calculation production process, it is the distortion amendment method which amends distortion of image pick-up data, and the above-mentioned focus calculation production process is processing-object-located.

[Claim 3] The correction function storage section which is the image-distortion compensator which amends distortion of an image from image pick-up data obtained with image pick-up equipment, and memorizes a correction function for amending image pick-up data, An amendment means to amend image pick-up data using a correction function read from this correction function storage section is included. The above-mentioned correction function storage section From image pick-up data of a pattern for proofreading whose arrangement of the focus is known, extract the focus and among the obtained focus A location of a thing near the center in image pick-up data, Based on data about a pattern for proofreading, a mapping function which assumed image pick-up equipment to be a pinhole camera is computed. An image-distortion compensator mostly characterized by memorizing a correction function obtained based on a criteria location of the focus of image pick-up data which computed a criteria location in image pick-up data of the focus all over the districts, and was obtained, and a location of the focus in image data using an obtained mapping function.

[0001]

[Industrial Application] This invention relates to the image processing which obtains the image which processes the image pick-up data obtained with image pick-up equipment, and does not have distortion.

[0002]

[Description of the Prior Art] Conventionally photoing an object object and a surrounding condition is performed by image pick-up equipments, such as a CCD camera, and processing the obtained image pick-up data and detecting an objective location is performed. Especially, in the intelligent robot who acts independently within general environment while judging a condition himself, the vision of a three dimension is important, and to recognize an objective three-dimension location correctly from the image pick-up data obtained with image pick-up equipment is desired.

[0003] Especially, as compared with the case where the camera tube till then is used, distortion of an image decreases sharply by use of a CCD camera, and an exact image without distortion is obtained increasingly. Then, it is coming to be able to perform location recognition of a quite exact body by processing of the obtained image pick-up data. That is, an objective location can be recognized by modeling the digital image using a CCD camera etc. as transparent transformation.

[0004] However, the digital image obtained with the CCD camera also has distortion by various factors in fact, and a model is not wholly exact the bottom in transparent transformation. Then, conventionally, in case a three-dimension location is detected

from image pick-up data, various kinds of amendments are performed about image pick-up data, and improving the precision of detection is proposed.

[0005] for example, a scientific publication -- "-- the Information Processing Society of Japan research report [ ] -- Vol.92 and No. -- others [/ 7 p.115 - 118 January, 1992:Onodera] -- " -- **** -- the grid pattern drawn on the installed plate is photoed with image pick-up equipment so that it may intersect perpendicularly to the optical axis of a camera, and amending image pick-up data is shown. That is, it aims at amending distortion resulting from the aberration of a lens, and this example defines a suitable correction function in consideration of the property of this distortion. And a correction function is asked for a coefficient based on the comparison of the grid pattern which the physical relationship in the inside of three-dimension space understands beforehand to be image pick-up data for every pixel, and the boundary of a grid pattern being straight lines. And image pick-up data is amended using this correction function.

[0006]

[Problem(s) to be Solved by the Invention] Thus, distortion of an image can be amended using the relation between the location in the inside of three-dimension space, and the location picturized in the image, and recognition of an objective location etc. can be made more exact. However, it is necessary to install the target grid pattern etc. in a known location to image pick-up equipment including an above-mentioned example by the conventional technique, and it difficult to install correctly by fluctuation of the optical axis of image pick-up equipment etc. in fact. Therefore, there was a trouble that it could not amend correctly, by this technique.

[0007] This invention aims at obtaining the method of amending an exact image distortion in view of the above-mentioned technical problem, and equipment.

[0008]

[Means for Solving the Problem] This invention is the distortion amendment method in an image processing system which amends distortion of an image in image pick-up data obtained with image pick-up equipment. A focus extract production process of extracting the focus from image pick-up data of a plate describing a pattern for proofreading whose arrangement of the focus is known, A location of the focus of a predetermined number near the center in image pick-up data obtained by this focus extract means, Based on data about a pattern for proofreading, image pick-up equipment is assumed to be a pinhole camera. A mapping function calculation production process which computes a mapping function which shows both relation, and a criteria location calculation production process which computes a criteria-almost location in image pick-up data of the focus all over the districts of image pick-up data using a mapping function obtained

with this mapping function calculation means, Based on a location of the focus obtained by this criteria location calculation means, and a location of the focus in image data, it has a correction function calculation production process which computes a correction function for amending a location of the focus, and is characterized by using this correction function for distortion amendment of image pick-up data.

[0009] Moreover, it is the distortion correction function calculation method in an image processing system which amends distortion of an image in image pick-up data obtained with image pick-up equipment. A focus extract production process of having a checkered pattern and extracting an intersection location from image pick-up data about a pattern for proofreading whose arrangement of an intersection in a pattern is known as the focus, A correction function calculation production process which computes a correction function for amending a location of the focus based on a location of the focus obtained by this focus extract means, and data about a pattern for proofreading, It is the distortion amendment method which amends distortion of image pick-up data using a correction function obtained according to an implication and a correction function calculation production process. The above-mentioned focus calculation production process An evaluation value for every processing-object location is computed using a template which defines an operation means about image pick-up data of the circumference including a processing-object location. It is characterized by computing a boundary line of a pattern from a change condition of image pick-up data of the circumference computed from this evaluation value, and computing the focus from an intersection of this boundary line.

[0010] Moreover, the correction function storage section which is the image-distortion compensator which amends distortion of an image from image pick-up data obtained with image pick-up equipment, and memorizes a correction function for amending image pick-up data, An amendment means to amend image pick-up data using a correction function read from this correction function storage section is included. The above-mentioned correction function storage section A location of a thing near the center in image pick-up data in the focus which extracted the focus and was obtained from image pick-up data of a pattern for proofreading whose arrangement of the focus is known, Based on data about a pattern for proofreading, a mapping function which assumed image pick-up equipment to be a pinhole camera is computed. It is mostly characterized by memorizing a correction function obtained based on a criteria location of the focus of image pick-up data which computed a criteria location in image pick-up data of the focus all over the districts, and was obtained, and a location of the focus in image data using an obtained mapping function.

[0011]

[Function] Thus, according to this invention, by the comparison of the focus arrangement on the screen extracted from the image pick-up data of the plate describing the proofreading pattern with which the array of the focus has become settled, and the location in an actual screen, when a camera is assumed to be a pinhole camera, a mapping function is obtained. Since it is asking for the mapping function by this technique, the plate describing a proofreading pattern can be applied also in the location of arbitration, and it is not necessary to search for the physical relationship of a camera and a plate with other means.

[0012] By this technique, it asks for a mapping function only using the whole screen or some data, and it can amend so that it may be suited. However, if the image amendment before of an image and after amendment uses the mapping function which is well in agreement, there will be few amounts of amendments of a location, the deficit in the flash from a screen and the side edge by the contraction will decrease, and a desirable effect will be acquired. Then, by this technique, the data near the center of a screen has a small distortion in many cases, and a mapping function is obtained using the data near a center using the property which is well in agreement with the image obtained from the pinhole camera.

[0013] Next, the criteria-location of the focus of the whole screen is computed using this mapping function. And a correction function is computed from the comparison of this criteria location and the location on an actual screen. For this reason, compared with the case where distortion of an image is amended, a suitable correction function is only computable from the location on a screen. And suitable image data can be amended using this correction function.

[0014] Furthermore, according to this invention, in the case of detection of the focus, the boundary line of a pattern is detected from the change condition of not only the processing for every pixel but pixel data, and the focus is detected according to the condition of this boundary line. For this reason, location detection of the exact focus can be performed compared with the processing for every mere pixel.

[0015] moreover -- thus, since image pick-up data is amended using the obtained correction function, an image without distortion can be obtained, according to the image processing, suitable location detection etc. can be performed and the precision of measurement of the environment condition in a robot etc. can be improved.

[0016]

[Example] Hereafter, the example of this invention is explained based on a drawing.

[0017] Drawing 1 is the block diagram showing the whole location detection equipment

configuration concerning this invention. A picture input device 10 consists of CCD cameras etc., changes into a digital signal the analog video signal acquired as a luminance signal for every pixel by the A/D converter, and outputs it. the data from a picture input device 10 is supplied to the input image data storage memory 12 -- having -- the usual case -- one frame (one screen) -- it memorizes here.

[0018] And the image data by which reading appearance was carried out is supplied to image data correction equipment 16 through a switch 14 from here. This image data correction equipment 16 has memorized the correction function beforehand, amends the image data for every pixel supplied from the input image data storage memory 12 using a correction function, and supplies this to the output image data storage memory 18. This output image data storage memory 18 reads the data which memorizes the image data for one frame and is memorized here one by one, and supplies it to the image output unit 20. This image output unit 20 consists of CRT, and performs the display according to the image data memorized by the output image data storage memory 18. In the usual case, the data memorized by the output image data storage memory 18 is read synchronizing with a Vertical Synchronizing signal and a Horizontal Synchronizing signal, and through a D/A converter, it changes into a predetermined video signal and outputs to CRT. The display by which distortion of an image was amended in the image output unit 20 by this is performed.

[0019] Moreover, the image-processing section 22 is also connected to image data correction equipment 16. This image-processing section 22 performs various kinds of image processings (for example, pattern recognition) etc. based on the image data amended by image data correction equipment 16, and performs the shape recognition of the object in image data, location measurement to that object, etc. Here, this location measurement is good to prepare two picture input devices 10 and to detect by trigonometry etc. from processing of the input image data from two picture input devices 10.

[0020] On the other hand, focus detection equipment 24 is connected to the switch 14. Then, the image data stored in the input image data storage memory 12 can be supplied also to focus detection equipment 24 by switching a switch 14. That is, in performing the usual image processing and the output of an image, in case it supplies input image data to image data correction equipment 16 and computes the correction function in image data correction equipment 16 (at for example, the time of initialization), a switch 14 is switched so that input image data may be supplied to focus detection equipment 24.

[0021] Focus detection equipment 24 processes the input image data supplied, for example, detects the location of the focus, such as a checkered intersection. And this

detection result is supplied to the focus location storing memory 26. In the usual case, the input image data for one frame is processed, and the data about the location of the focus extracted out of this is stored in the focus location storing memory 26.

[0022] Next, the data about the location of the focus for which the focus location storing memory 26 was asked from the input image is supplied to the mapping function listing device 28. This mapping function listing device 28 assumes that it is that to which a picture input device 10 operates as a pinhole camera, and the mapping function of a picture input device 10 is computed from the data inputted. And the mapping function detected by the mapping function listing device 28 shifts, and is supplied to detection equipment 30. To this gap detection equipment 30, the data about a focus location is also supplied from the focus location storing memory 26, and the comparison of the criteria location of the focus obtained using the mapping function and the location of the detected focus detects both gap to it. The correction function listing device 32 is connected to this gap detection equipment 30, and from the gap supplied, this correction function listing device 32 computes the correction function for amendment to the data obtained by the mapping function, and supplies this correction function to the correction function storing memory 34.

[0023] Then, image data correction equipment 16 can read the correction function memorized by the correction function storing memory 34, and can supply the image data which amended input image data and was amended by this in the right location at the output image data storage memory 18 and the image-processing section 22.

[0024] Drawing 2 is a flow chart which shows the actuation by the whole correction function calculation of this example. Thus, in this equipment, the focus is extracted by processing input image data in focus detection equipment 24 (S1). Next, the location on the pattern of the obtained focus is determined (S2). And based on the data about the focus with which the location on a pattern was determined, and the photoed data about the pattern for a configuration, the correction function for detection of the gap in the data processed and obtained with creation of a mapping function and a mapping function and the gap dissolution based on these detection values is created, and a correction function is determined (S3).

[0025] The flow chart for explaining actuation of a focus extract to extract drawing 3 of the focus is shown. First, in this example, for correction function calculation, a specific proofreading pattern is prepared and a correction function is computed by image data processing about this proofreading pattern. Then, detection of the focus in a proofreading pattern performs detection of this focus.

[0026] In this example, a checkered pattern as shown in drawing 4 as a specific pattern

is used, and let the intersection of this checkered pattern be the focus. Then, first, a template is hit to image data and the map of the value is made (S11). Here, the data about the circumference pixel of 36 including the processing-object point shown by the round mark as indicates to be a template to drawing 5 is processed, and the value of the point is calculated. In this example, the value about that pixel is added about the data of the nine upper left, and the data of the nine lower right, and the data about that pixel is subtracted about the data of the nine upper right, and the data of the nine lower left. By performing such processing, the value of the data processed by the template turns into maximum or the minimum value in the focus (intersection) of a checkered proofreading pattern. Then, the value for each point is calculated about all the data for one frame using this template. In addition, in here, the value about each point takes the absolute value. Then, each intersection will take the maximal value.

[0027] Next, the location according the nearby maximal value to Rhine fitting is computed to ejection (S12) and its point in order from the map obtained by doing in this way (S13). And the focus location computed by this Rhine fitting is outputted (S14). And S12-S13 are repeated to the last maximum point (S15).

[0028] Next, Rhine fitting in S13 is explained. If the focus is computed by processing using a template, this location will serve as a point of the one maximal value. And when the above templates are used, the actual focus should take the lead in the square formed at the maximum point, and this right, the lower right and three lower points. However, in actual measurement, a proofreading pattern does not restrict being arranged to a camera (picture input device 10) at the right angle, and a square center is not necessarily a right focus location in it.

[0029] Then, in this example, as shown in drawing 6 (A) - drawing 6 (C), the coordinate of the focus is searched for from the change condition of the surrounding image data of the called-for focus. For example, binarization of the image data is carried out to 0 or 1 with a predetermined threshold, and it asks for a bordering straight line type from the change condition of this binarization data. A vertical straight line type can calculate the absolute value of the differential value which can be set horizontally, as shown in drawing 6 (B), it can search for the point that a value is big, one by one, and can search for it by the formula of the straight line which passes along these points. Moreover, a horizontal straight line type can differentiate the value for every vertical pixel, as shown in drawing 6 (C), and it can ask for the formula of the straight line which passes along the point that the absolute value of a differential value is big. And a focus coordinate can be searched for by asking for the intersection of two obtained straight line types. For example, according to the example of drawing 6 , the coordinates of the

focus for which it asked from the template are (5.5, 5.5), but the horizontal straight line for which it asked as mentioned above is 2X+10Y-65=0, and a vertical straight line is 10X+2Y-69=0. Then, the intersection of these two straight lines is set to (35 / 6= 5.833, 32/6=5.333), and can ask for a more exact focus location.

[0030] Thus, with the coordinate of the focus called for only from the data only obtained by the template, the exact focus in consideration of the inclination of the proofreading pattern which is not called for etc. is detectable.

[0031] In order to determine not the location detected on image pick-up equipment (on a screen) but the location used as the criteria on count about the location, next the focus called for as mentioned above on the pattern of the focus, the location on the pattern (location on the array corresponding to a proofreading pattern) is determined. That is, a procedure as shown in drawing 7 determines the location on the pattern of the focus. In addition, the coordinate on (X, Y), and a pattern is expressed with (m, n) for the coordinate on a screen.

[0032] First, the obtained focus is sorted in the order near the center of a screen (S61). And the four directions of the central point are determined in the following logic about the sorted focus (S62).

[0033] That is, the four directions of the central point are determined according to a flow chart as shown in drawing 8 . First, the first point P0 (X0 and Y0) which is a point nearest to the center of a screen is set into ejection, and this point is set as =(m, n) (0 0) = center (S21). Next, let the point P1 (X1 and Y1) near a center into ejection at that degree, and let this point be =(m, n) (1 -0) = left (S22). Next, it judges whether ejection (S23) and this point are right about the point P2 (X2 and Y2) near a center to that degree (S24). The following operations of the coordinate of a main point and the coordinate of a left point perform the judgment of whether to be this right.

[0034] X2 - =2X0-X1 Y2 -=2Y0-Y1 [and] -- by such judgment, when P2 (X2 and Y2) is the right, let this point P2 (X2 and Y2) be the P2 = (1 0) right (S25). And the point P3 (X3 and Y3) near a center next is made into a P3 = (0 -1) top (S26), and the following point P4 (X4 and Y4) is made into the bottom of =(m, n) (0 1) = (S27).

[0035] On the other hand, in S24, when P2 (X2 and Y2) is not the right, the point P2 (X2 and Y2) is made into =(m, n) (0 -1) = top (S28). And it judges whether ejection (S29) and this point are right about the point P3 (X3 and Y3) near a center next (S30). The judgment of whether to be this right is that point P3 like an above-mentioned case. Left P2 And center P0 Whether it has an above-mentioned relation performs. And it sets to S30 and is P3. When judged with it being the right, a point P3 (X3 and Y3) is made into =(m, n) (1 0) = right (S31), and the following point P4 (X4 and Y4) is made into the

bottom of =(m, n) (0 1) = (S32).

[0036] Moreover, when a point P3 (X3 and Y3) is not the right in S30, make a point P3 (X3 and Y3) into the bottom of =(m, n) (0 1) = (S33), and let the following point P4 (X4 and Y4) be =(m, n) (1 0) = right (S34).

[0037] Thus, let the point nearest to a center be the left first (S22). And when there is no point (the 2nd) near a center next in the opposite side (right-hand side) of the point made into the left, that point is made into a top (S28), and the point (the 3rd) near that degree judges whether it is the right, and if it is not the right, make this point into the bottom (S33), and let the point (the 4th) near that degree be the right (S34). On the other hand, if the point near the 3rd is the right, this will be made into the right (S31) and the point near the 4th will be made into the bottom (S32). Moreover, if the point near the 2nd is the right, this will be made into the right (S25), the point (the 3rd) near the degree will be made into a top (S26), and the 4th will be made into the bottom (S27). Such processing determines the location on the pattern of the point of the four directions of the surrounding focus of the central point.

[0038] Thus, when the location on the pattern of the point of the four directions of the central point is determined, the location on the pattern of each point is determined next (S63). This is performed in the following logic. In addition, it sets to the following explanation and is Subscript c. A center and r The right and l For the left and a top, the bottom is [u and] d. It is shown.

[0039] That is, a procedure as shown in drawing 9 and drawing 10 performs. Although this processing is performed about all the focus, one-point Pc = (m, n) (mc and nc) nearest to a center is taken out out of the point which must be processed first (S41). In the case of the first loop, it is this point Pc. It becomes center (m, n) = (0 0). And this point Pc It considers as criteria and the point on the left of this point is determined as follows (S42). Namely, point Pc It judges whether it receives, and left point Pl = (m, n) (mc-1 and nc) does not exist, and right-hand side point Pr = (m, n) (mc+1 and nc) exists (S421). In corresponding to this condition, it looks for a point with the coordinate near (2Xc-Xr and 2Yc-Yr) on that screen out of the extracted focus (S422). Namely, point Pc taken out first Pr which already exists The coordinate on the screen of a point to point Pc A left-hand side point is looked for. And when the point of this left-hand side is found, let (S423) and its point be Pl =(m, n) (mc-1 and nc) = left (S424). Moreover, when the point which corresponds in S423 when there is nothing that corresponds in S421 is not found, it moves to the following activation of S43 as it is.

[0040] And according to the same procedure as these S42, a Pr =(m, n) (mc+1, nc) = right and Pu =(m, n) (mc, nc-1) = top and the bottom of Pd =(m, n) (mc, nc+1) = are

determined (S43, S44, S45). Next, upper left point Pul(m, n) = (mc-1, nc-1) is determined (S46). For this reason, it judges whether Pul(m, n) = (mc-1, nc-1) exists first (S461). And when this point Pul does not exist, it judges whether left-hand side point Pl = (m, n) (mc-1 and nc) or upper point Pu = (m, n) (mc, nc-1) exists (S462). And these two points Pl And Pu When both exist and it is set to NO in S462, a point with the coordinate near (Xl+Xu-2Xc and Yl+Yu-2Yc) on a screen is looked for out of the focus (S463). That is, the point of the upper left is looked for from three known points.

[0041] And when the point in this coordinate is found, let (S464) and its point be the Pul(m, n) =(mc-1, nc-1) = upper left (S465). Here, when the upper left point Pul already exists in S461, or when there is no point which corresponds in S464, it moves to the following activation of S47.

[0042] And the same procedure determines the Pdl(m, n) =(mc-1, nc+1) = lower left, the Pur(mc+1, nc-1) = upper right, and the Pdr(m, n) =(mc+1, nc+1) = lower right (S47, S48, S49). And the point made into the processing object judges whether it is the last point (S50), and repeats such processing to the last point.

[0043] Thus, in relation with the point already determined one by one, the relative position is determined from the point near a center.

[0044] Thus, by above-mentioned logic, the location on a pattern can be determined about each point, and a 2-dimensional coordinate (m, n) is given about these.

[0045] When determining the location on a pattern as mentioned above, it does not become considering the point of the location used as a checkered intersection as the focus. And when the pattern location of the focus extracted by the above-mentioned procedure is determined, a location is not determined about the focus as which the location was determined, and the point which is not in specific relation. Although the extract was carried out as the focus, this is the point which must not exist and removes such the isolated point from the data of a specific pattern (S64).

[0046] Thus, about each focus, the location (X, Y) and pattern location (m, n) on a screen are determined, and this is memorized by the focus location storing memory 26.

[0047] As it is the decision **** of a correction function, when the location on the pattern (m, n) is altogether determined about the focus obtained from image data, it asks for a correction function from the location of these focus, and the configuration of a specific pattern. That is, a procedure as shown in drawing 11 determines a correction function. First, it asks for a mapping function from the pattern location (m, n) of the focus where the relative location called for as mentioned above was determined, and the concrete location on a screen (X, Y) (S51). Here, although it asks for this mapping function, not all the focus uses, but it uses only the focus of 1/4 near a center for it. This

is because it is thought that there is little nonlinear distortion etc. and it can ask for the mapping function near a subject-copy image about the point near a center.

[0048] Next, the location which serves as criteria about the focus asked for the location on all patterns is computed using the called-for mapping function (S52). Next, the criteria location called for by the mapping function is compared with the locations X and Y on an actual screen, and it asks for both gap, and asks for the correction function for amending this gap (S53). And the called-for correction function is outputted to the correction function storing memory 34, and it memorizes here (S54).

[0049] calculation of a mapping function -- here, calculation of a mapping function is explained. The actual photography in a camera can be ideally approximated to photography by the pinhole camera. That is, as shown in drawing 12 , the light from one point [of three-dimensions space] P is projected on an image pick-up side (plane) through a focus. And the image on an image pick-up side is memorized by the input image data storage memory 12 through photo electric conversion and an AD translation. And the location on this memory 12 (X, Y) turns into a location on a screen. And according to the pinhole camera model, it is known that there are [relation of the following linear functions (mapping function) between X and Y] a location on a pattern (m, n) and a location on a screen.

[0050]

$$X=(cm+dn+e)/(am+bn+1)$$

$$Y=(fm+gn+h)/(am+bn+1)$$

Therefore, about the focus of a large number extracted as mentioned above, the location on this pattern (m, n) and the location on a screen (X, Y) are substituted, and each constant a-h is calculated with the least square method. The mapping function at the time of assuming the camera in this system to be a pinhole camera by this is determined. In addition, this least square method is shown, for example in the Iwanami Shoten issue "Iwanami lecture information science 18 numerical calculation (the January 8, Showa 57 1st ******)" etc.

[0051] And the focus used in order to ask for this mapping function makes only a near thing (the focus of the whole quadrant) from a center. The portion with this near a center is because it is considered to be the right to approximate with a pinhole camera. Then, it asks by correlation with each high coefficient from the focus such near the center, and a mapping function with a high precision is called for.

[0052] Since the degree which moves a relative position to a criteria location was asked for the mapping function as mentioned above, the location which used this mapping function about all the extracted focus is computed. That is, when a picture input device

10 is a pinhole camera, the location on the count in which each focus as which the location on a pattern (m, n) was determined should be located is determined by the above-mentioned mapping function. Then, a criteria-location (x y) is computed using a mapping function about all the focus as which the location on the extracted pattern (m, n) was determined.

[0053] Calculation of a correction function, next the criteria location (x y) called for by doing in this way and the location on an actual screen (X, Y) are compared, both gap is detected, and it asks for the correction function for canceling this gap. This correction function is performed by determining each coefficient with the least square method using the following polynomials.

[0054]

x=a1 X4+b1 X3 Y+c1 X2 Y2+d1 XY3+e1 Y4 + f1 X3+g1 X2 Y+h1 XY2 + i1 Y3+j1 X2+k1 XY+l1 Y2+m1 X+n1 Y+o1 y=a2 X4+b2 X3 Y+c 2X2Y2 + d2 XY3+e2 Y4+f2 X3+g2 X2 Y+h2 XY2+i2 Y3+j2 X2+k2 XY+l2 Y2+m2 X+n2 Y+o2 Thus In this example, a criteria location (x y) is computed about all the focus on a screen using the mapping function which asked for the camera from the focus near the center of a screen the bottom wholly as a pinhole camera, and was called for in the mapping function of a case. And a correction function is computed by the comparison with the computed criteria location (x y) and the location on an actual screen (X, Y). Therefore, it can ask for a very exact correction function compared with the case where it is going to amend distortion of an image as it is.

[0055] Moreover, each focus will be outputted to a location when a picture input device 10 operates as a pinhole camera by memorizing this correction function in the correction function storing memory 34, amending the image data supplied from the input image data storage memory 12 using a correction function, and displaying on the image output unit 20. Therefore, when displaying various images, an image without distortion picturized with the pinhole camera can be outputted to the image output unit 20.

[0056] Furthermore, that a picture input device 10 can be operated as a pinhole camera can grasp correctly the location of the photoed object actual from the location of each image when image data is processed by the image-processing section 22, and when a stereo image etc. is used, it can perform the processing measuring-point measurement correctly.

[0057]

[Effect of the Invention] As explained above, according to this invention, the focus is extracted from the proofreading pattern drawn on the plate, and a mapping function is created from the location on the screen of the focus near a photograph center. And the

ideal location of the focus is computed about the focus of the whole screen using this mapping function, and a correction function is computed from the comparison with this criteria location and the location of the focus of the whole screen. Therefore, it becomes measurable, without measuring installation or a location for a plate correctly, and pinpointing the location of the pattern, and a correction function will become very exact, and image data can be amended using this.

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram showing the whole example configuration.

[Drawing 2] It is a flow chart explaining whole actuation.

[Drawing 3] It is a flow chart explaining focus extract actuation.

[Drawing 4] It is explanatory drawing of a checkered proofreading pattern.

[Drawing 5] It is explanatory drawing showing the configuration of a template.

[Drawing 6] It is drawing explaining actuation of Rhine fitting.

[Drawing 7] It is the flow chart of the actuation for determining the relative value of the focus.

[Drawing 8] It is the flow chart which shows the procedure of determining the four directions of the focus.

[Drawing 9] It is the flow chart which shows the procedure of determining the relative position of the focus.

[Drawing 10] It is the flow chart which shows the procedure of determining the relative position of the focus.

[Drawing 11] It is a flow chart explaining actuation of correction function decision.

[Drawing 12] It is explanatory drawing explaining the principle of a pinhole camera.

[Description of Notations]

10 Picture Input Device

12 Input Image Data Storage Memory

16 Image Data Correction Equipment

18 Output Image Data Storage Memory

20 Image Output Unit

22 Image-Processing Section

24 Focus Detection Equipment

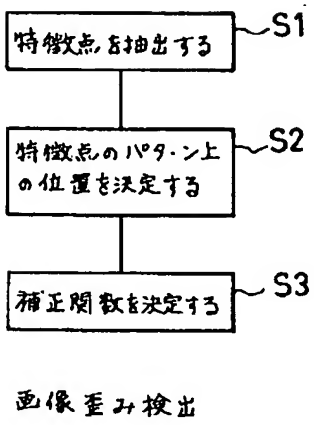
26 Focus Location Storing Memory

28 Mapping Function Listing Device

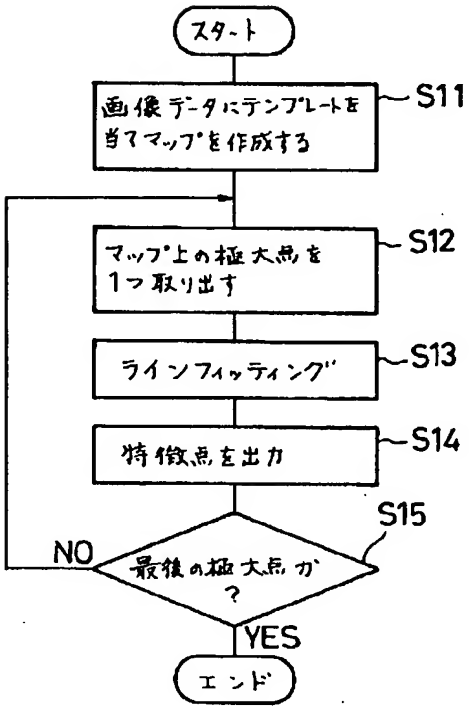
30 Gap Detection Equipment

32 Correction Function Listing Device

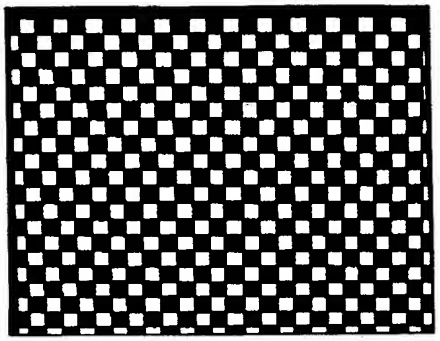
[Drawing 2]



[Drawing 3]

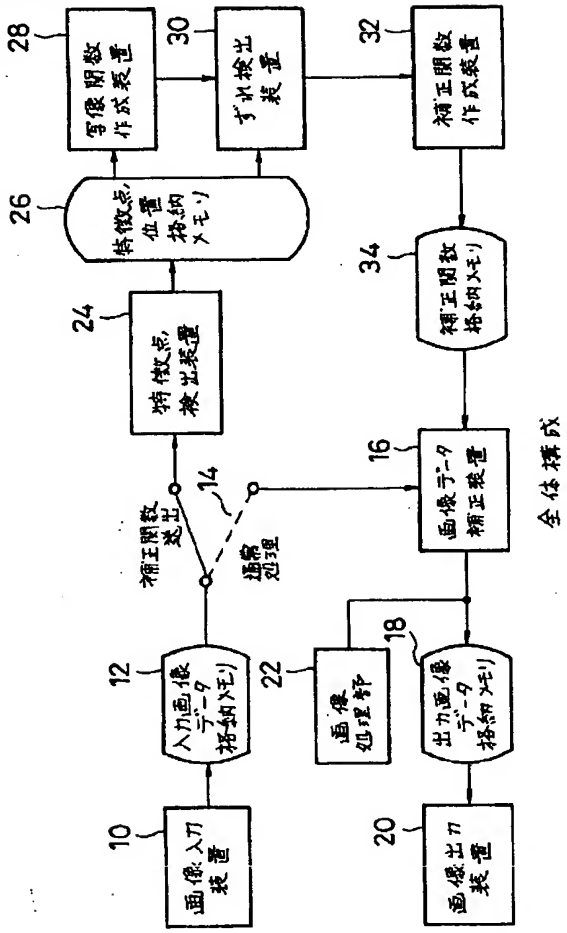


[Drawing 4]

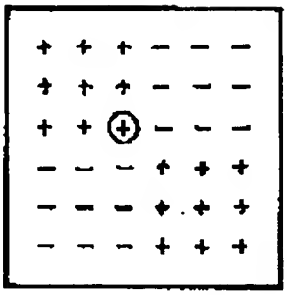


較正パターン

[Drawing 1]

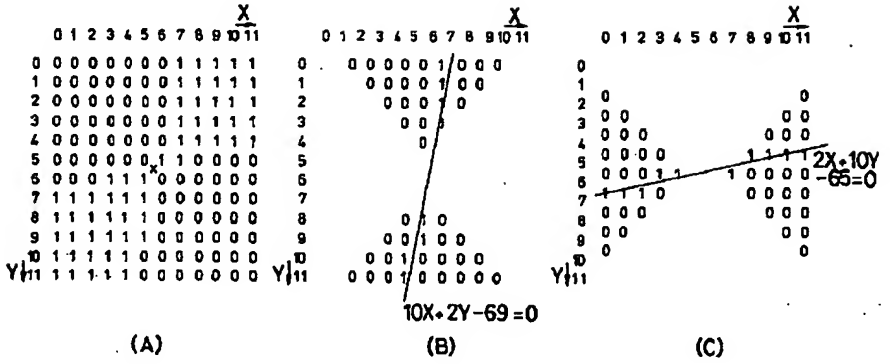


[Drawing 5]

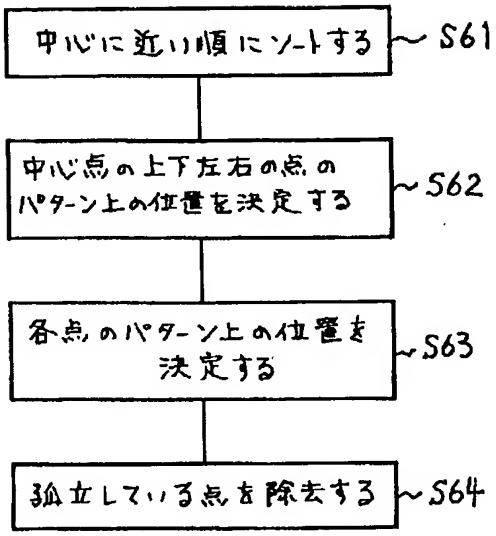


テンプレート

[Drawing 6]

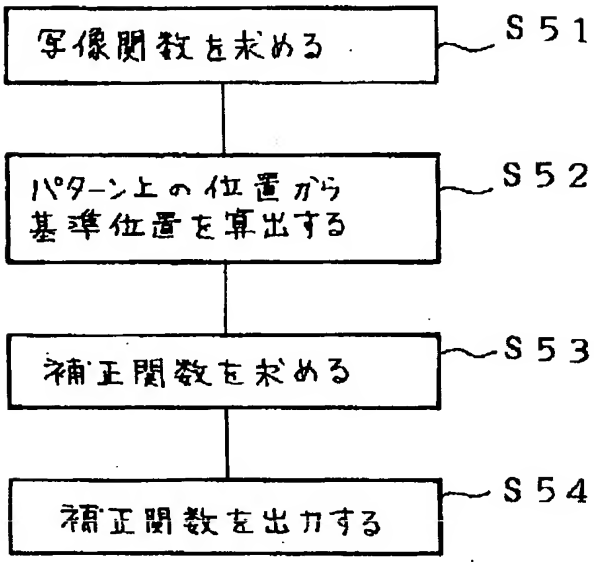


[Drawing 7]



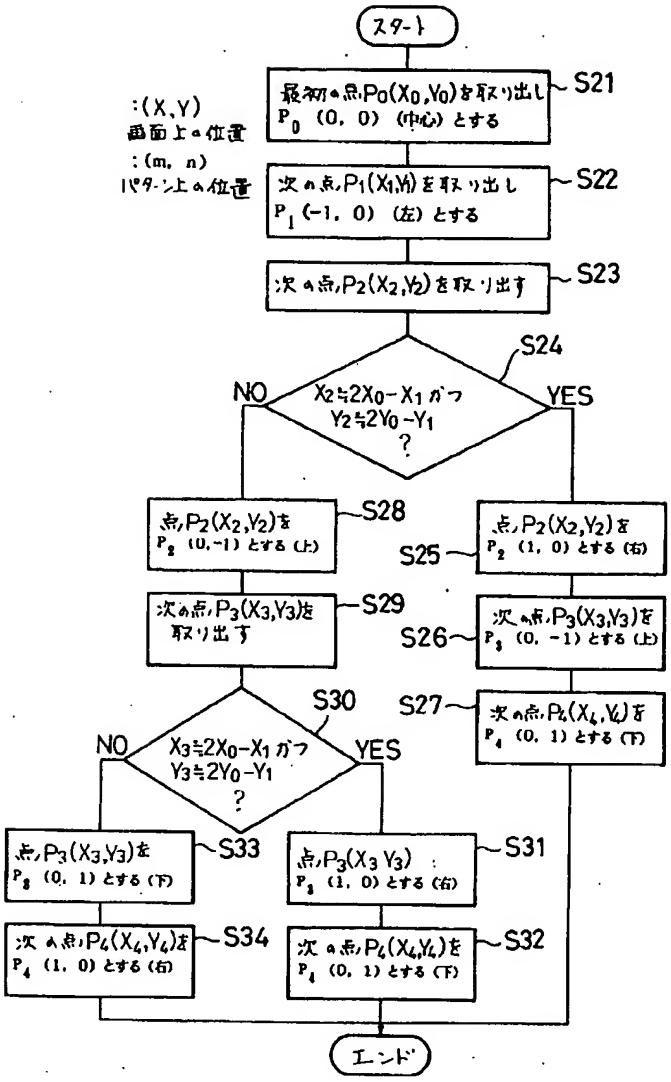
相対位置の決定

[Drawing 11]

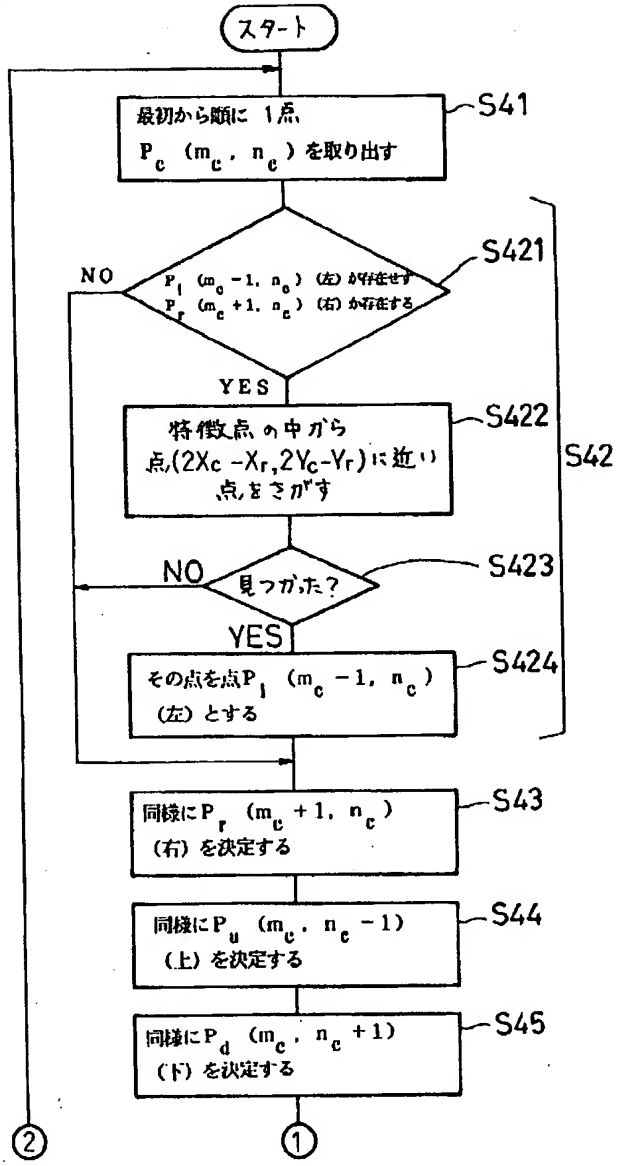


補正関数の決定

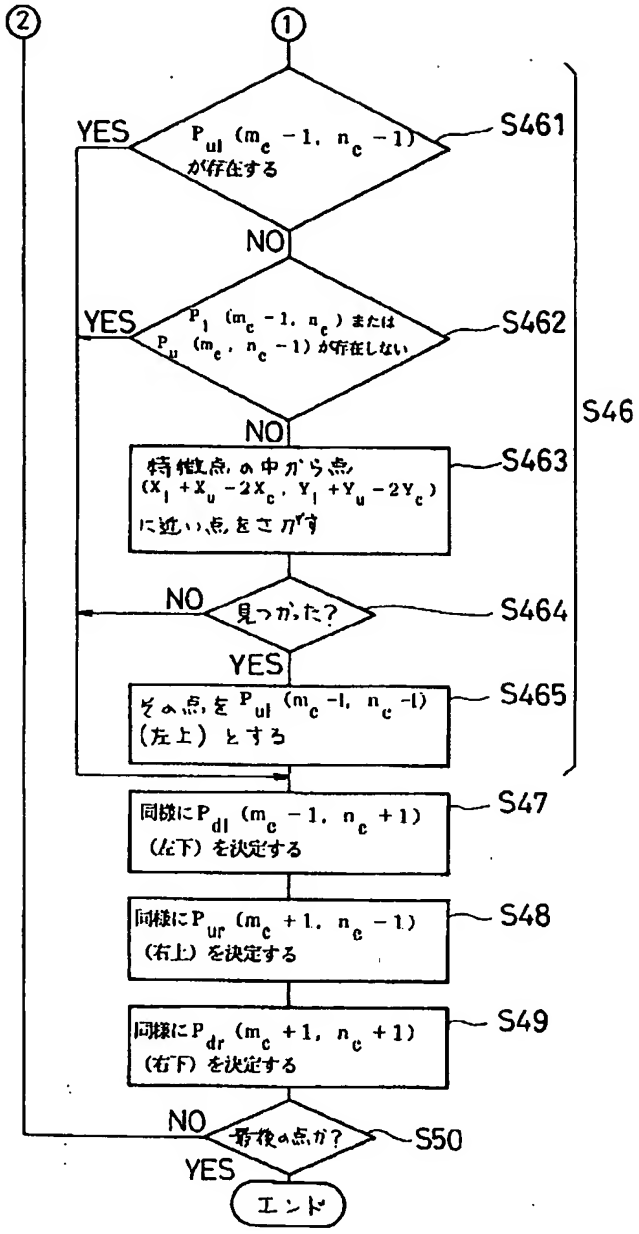
[Drawing 8]


スタート
:(X,Y)
画面上の位置
:(m, n)
パターン上の位置
最初の点P0(X0,Y0)を取り出し
P0 (0, 0) (中心) とする
S21
次の点P1(X1,Y1)を取り出し
P1 (-1, 0) (左) とする
S22
次の点P2(X2,Y2)を取り出す
S23
S24
X2≒2X0-X1 かつ
Y2≒2Y0-Y1
?
NO
YES
点P2(X2,Y2)を
P2 (0,-1) とする (上)
S28
点P2(X2,Y2)を
P2 (1, 0) とする (右)
S25
次の点P3(X3,Y3)を
取り出す
S29
次の点P3(X3,Y3)を
P3 (0, -1) とする (上)
S26
S30
X3≒2X0-X1 かつ
Y3≒2Y0-Y1
?
S27
次の点P4(X4,Y4)を
P4 (0, 1) とする (下)
NO
YES
点P3(X3,Y3)を
P3 (0, 1) とする (下)
S33
点P3(X3,Y3)
P3 (1, 0) とする (右)
S31
次の点P4(X4,Y4)を
P4 (1, 0) とする (右)
S34
次の点P4(X4,Y4)を
P4 (0, 1) とする (下)
S32
エンド

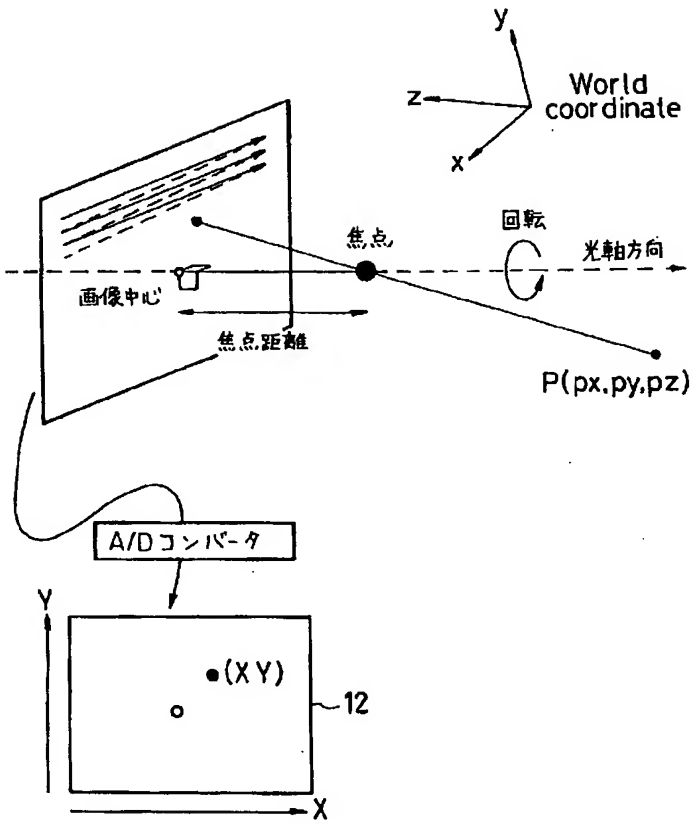
[Drawing 9]


スタート
最初から順に 1点
P_c (m_c, n_c) を取り出す
S41
NO
P_l (m_c −1, n_c) (左) が存在せず
P_r (m_c +1, n_c) (右) が存在する
S421
YES
特徴点の中から
点(2Xc −Xr, 2Yc−Yr)に近い
点をさがす
S422
S42
NO
見つかった?
S423
YES
その点を点P_l (m_c −1, n_c)
(左) とする
S424
同様にP_r (m_c +1, n_c)
(右) を決定する
S43
同様にP_u (m_c, n_c −1)
(上) を決定する
S44
同様にP_d (m_c, n_c +1)
(下) を決定する
S45
②
①

[Drawing 10]


②
①
YES
$P_{ul}(m_c-1, n_c-1)$ が存在する
S461
NO
YES
$P_l(m_c-1, n_c)$ または $P_u(m_c, n_c-1)$ が存在しない
S462
NO
特徴点の中から点 $(X_l+X_u-2X_c, Y_l+Y_u-2Y_c)$ に近い点をさがす
S463
S46
NO
見つかった?
S464
YES
その点を $P_{ul}(m_c-1, n_c-1)$ (左上) とする
S465
同様に $P_{dl}(m_c-1, n_c+1)$ (左下) を決定する
S47
同様に $P_{ur}(m_c+1, n_c-1)$ (右上) を決定する
S48
同様に $P_{dr}(m_c+1, n_c+1)$ (右下) を決定する
S49
NO
最後の点か?
S50
YES
エンド

[Drawing 12]



ピンホールカメラモデル